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ABSTRACT

The inabilitiy of the traditional education system to pay attention to the individual needs of students has been a central obstacle to effective education since the demand for universal education first led to the formation of rigidly-structured large schools and classrooms. Use of computers now removes the need to teach all students the same material, in the same way, at the same time. Therefore, new approaches to assessing student progress and achievement may be needed, as well as new perceptions of what constitutes an educational institution. However, if the computer is introduced into the present institutions without major changes in teaching methods, teacher training and expectations, and administrative structure, then the power of these machines to aid education will be dissipated. Computers can be used to improve effectiveness and productivity, to teach basic skills requiring drill and practice, to provide an alternative to textbooks, and to free educators to effectively teach students to use information to solve specific problems. However, computers must not be used simply to automate the mistakes of the past. (LMM)

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Speech Discours

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Notes

for a speech

by

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Chairman

Science Council of Canada

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Canadian Education Association

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on

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Theme

The central idea to be developed in the speech is the importance to students, teachers and society as a whole of taking advantage of the increased flexibility computers are capable of introducing into the educational system.

Preamble

The Science Council of Canada has been examining the relationship between the education system and the computer and communications revolution in the context of two of its research endeavours.

a) In its report about the implications of the computer revolution for all segments of Canadian society, Planning Now for an Information Society, the Council has looked at the potential role of computers in classrooms as well as the role of schools in helping society adjust to the information age (e.g. computer literacy, skilled personnel).

b) In the context of its ongoing study of the present and potential state of science education in Canadian schools, the Council has examined the potential for computers to alter the science curriculum specifically. The possible contributions of computer technology to the teaching and understanding of science have been examined (e.g. in simulations). As well, changes in the kind of science students need to be taught (in light of the capacity of computers to provide information) are being considered.

Introduction

Perhaps the most commonly cited obstacle to effective education has been the requirement for one teacher to deal with groups of students of widely varying ability levels, interests, and rates of development. By and large, the system has tailored its curriculum and its teaching methods to meet the needs of a mythical "average" student. First of all, this has meant that at any point in time a significant number (if not most) of the students are either being left behind because they do not understand, or they are not being challenged or interested because they have already gone beyond the material and concepts being presented.

Secondly, it has led to the rather arbitrary classification of students as either "gifted", "average", or "slow" when in fact, as Joseph Renzulli (an American educator concerned with the development of enrichment programs) has pointed out;

> "giftedness is not something a person has all the time or not at all. Rather, people display 'gifted behaviour' at particular times and in specific content areas."

Renzulli defines "giftedness" as above average (though not necessarily superior) general ability, combined with the task commitment, and the creativity required to generate diverse and novel products and solutions to problems.

The rigid "classroom" grouping and lock-step approach to learning presently used in most schools makes it difficult to encourage a student to develop or expand his interest and experience in an area for which he may have a particular gift. Even students generally regarded as being quite average in ability may have areas or moments of "giftedness" which are lost or suppressed by the need to progress in all areas at the same rate as a classroom of other students. Our present enrichment programs tend in most cases to identify as "gifted" a small number of students who do well on specific tests and to separate these students into a select group which is then exposed to a more diverse and "enriched" educational environment. The gifts of the students who do not happen to score as well on such tests are less likely to be specially cultivated.

The Opportunity

This inability to pay attention to the individual needs of students has been a central obstacle to effective education since the demand for universal education first led to the formation of large schools and classrooms in their present rigidly structured form. Computers now offer educators a way of overcoming this obstacle by removing the need to teach all students the same material, in the same way, at the same time. They provide us with a means to tailor instruction to each individual student's needs and to free the teacher from many more frustrating and unproductive tasks. They can be used to tear down artificial barriers and hurdles that have been erected to cope with the need to ensure that large numbers of students reach a certain level of competence in all subject areas at the same time.

It seems likely that a whole new approach to assessing student progress and achievement may be needed. If students do not need to progress through the system in groups, the concept of grade levels loses much of its significance. Examinations that test recall ability may be inappropriate in a system geared to developing problem-solving abilities and critical thinking. Teachers ought to find that many of the hours presently spent correcting and grading work can be eliminated, and that the time available for developing truly creative teaching strategies, and for keeping up to date in their own subject areas is correspondingly increased. Computers could free the teacher from the need to act primarily as an "information giver" and could provide the opportunity to interact on a one-to-one basis with students.

Computers not only eliminate the need for all students to learn the same thing at the same time, they also reduce the need for them all to be in the same place at the same time. There is no inherent reason why a student using a computer program to learn grammar rules, chemistry equations, or spelling should be sitting in a traditional classroom. He or she could easily be at home, in a museum, a library, or even at work. This opens the door for students to move out more into the community and the workplace.

Ultimately, particularly with older students, one can imagine a system in which students in all sorts of different locations -- at home, on field trips, and at work -- can access and use information and programs as needed. The school would become a resource centre with counsellors and other information sources available for student use.

These scenarios imply changes in our perception of what constitutes an educational institution, both with regard to structure and the roles of teachers and administrators. In order to fully exploit the potential of computers, we must be willing and able to rethink educational objectives.

If we attempt to "graft" the computer onto the present institutions without major changes in teaching methods, teacher training and expectations, and adminstrative structure, then the power of these machines to help us will be dissipated.

Attempts to introduce new ideas, new curricula, and new technologies or to institute innovative teaching methods have often seemed to produce relatively small or non-existent changes in ultimate educational outcomes. It has been suggested (Olson and Reid, 1982, European Journal of Science Education) that this lack of impact results from the attempt to introduce an innovation into a school context which is already functioning with specific goals and mechanisms. Social relationships, teaching techniques, administrative methods, and so on, are already in place and work together in a balanced way. The innovation is often perceived to be a disruptive element which does not fit with already established methods and goals. As a result, basically well designed and thoughtful innovations may be managed in such a way that their purpose is defeated. This effect has been observed with respect to programmed instruction in the sixties (Carlson R., 1965) where the introduction was managed in such a way that its major benefit was lost (i.e. students were required to work on the same program at the same time).

Teachers are supposed to keep close track of what their students are doing and how well they are achieving. Computer instruction makes this very difficult as students progress at different rates, in different directions and may end up doing very different things at any one time. Teachers will feel uncomfortable with this apparent lack of control and they will have to be helped to adapt.

The human element in the teaching process is an essential one. Computer instruction should free the teacher to be involved in the really creative part of education, in stimulating interest and broadening a student's horizons. The teacher may really have an opportunity to ferret out an individual student's areas of "giftedness" and to help her take full advantage of them. But in order for this to occur, teachers must be properly prepared for the changes, and must be supported during the transition.

COMPUTERS MUST NOT BE USED SIMPLY TO AUTOMATE THE MISTAKES OF THE PAST! ANY ATTEMPT SIMPLY TO PLACE THE PRESENT SYSTEM AND METHODS ON A COMPUTER WILL PROBABLY BE NO MORE SUCCESSFUL THAN WAS THE VIDEOTAPE MACHINE. COMPUTERS PERMIT (AND DEMAND) THE RETHINKING OF OUR ENTIRE SYSTEM TO RESPOND TO INDIVIDUALS. THAT'S WHERE THE FUTURE LIES AND THE SOONER WE GET THERE, THE BETTER.

In a recent issue of CIPS, Drs. Brebner and Halworth of the University of Calgary reported a case study of the way in which computer technology can be used to improve our perceived effectiveness. In this study a computerized testing and diagnostic system was used to upgrade the basic reading skills of pupils in a socially and economically disadvantaged area in Calgary. Students were tested three times a year and specific skill problems were identified and fed back to both student and teacher by the computer. At the beginning of the project the school scored in the 25th percentile in comparison with other schools in the city on the Canadian Basic Skills Test. After the project, the school scored in the 55th percentile, an increase that would not have been expected on the basis of any other form of intervention. This level of improved efficiency in acquiring a very basic and important skill was achieved as a result of individualized instruction techniques made possible by the application of computer technology. In this age of spending restraints, inflation and recession, the public must inevitably become increasingly unwilling to pour more and more money into a system which does not appear to be operating efficiently. Educators, like industrial managers, must take advantage of the opportunities provided by computer technology to increase efficiency productivity.

Work dating back to the early '50s has shown how computers can teach basic skills that require drill and practice efficiently and effectively and without many of the negative side-effects normally associated with repetitive tasks. The computer obviously has infinite patience. It can repeat, redraft, and replay material for a student as often as necessary. It can pick up and feed back information regarding errors, and can present material in the manner most suited to a particular sort of student. Those

who do not understand are not intimidated by the need to ask questions in front of their peers and possibly a disapproving or unsympathetic teacher. The phenomenon currently referred to as "math anxiety" is thought to stem in part from early classroom experiences like this which cause students to feel stupid and incompetent with respect to mathematics. On the other hand, students who grasp ideas quickly become bored and restless when forced to sit through repeated explanations of the same material.

Properly exploited computer-based drill and practice exercises ensure all students acquire the basic skills -- spelling, typing, handwriting, vocabulary, grammar, and arithmetic -- which are prerequisite to the development of other more complex skills. This can be achieved without sacrificing the flexibility needed to cultivate creativity.

Thus we can end the battle between those espousing the "basics" and those opposing unpleasant, drill-type classroom activities. We can have the basics and the individual flexibility at the same time.

One of the major expenses involved in the secondary school system is the purchase of adequate numbers of up-to-date textbooks. Even at the current rate of generation of new knowledge (doubles every 5 years in science and this rate will likely increase significantly as computer use increases) the standard text in any subject can be rendered obsolete within a relatively short period of time. Computers provide students with access to a continually updated current source of information from electronically stored data bases. These sources can be altered instantly as information is added or changed, and while they may not completely replace the textbook, they decrease the need for continual revisions.

Changing Objectives for the "Information Age"

Education is one of our society's largest and most obvious "information industries." It is now almost a cliché to suggest that information, as a product and business will soon dominate the economy of our country and that of all the developed countries.

In this information age, educators will need to develop different skills and different approaches to problem solving, both for themselves and for their students. When information is available at the touch of a finger to a keyboard, the important skills for individuals are those that enable them to use that information to solve specific problems, to criticize, assess and manipulate data to form new conclusions. We try, with difficulty, to teach these skills today; the computer may finally free us to do those tasks effectively. If we, and our institutions are truly open to change and don't simply try to ensnare the computer in our existing system, the rewards are likely to be great even beyond our present comprehension or prediction. Change requires courage and skill - I trust we will not be found lacking.